11.03.00

**Case Docket No. PHD 99,151**

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COMMISSIONER FOR PATENTS, Washington, D.C. 20231

Enclosed for filing is the patent application of Inventor(s):
**MICHAEL BROESAMLE**

For: **FILM SCANNER WITH AN AUTOMATIC FOCUSING DEVICE**

***ENCLOSED ARE:***

[X] Associate Power of Attorney;
[X] Information Disclosure Statement, Form PTO-1449 and copies of documents listed therein;
[X] Preliminary Amendment;
[X] Specification (8 Pages of Specification, Claims, & Abstract);
[X] Declaration and Power of Attorney:
(1 Pages of a [ ]fully executed [X]unsigned Declaration);
[X] Drawing (1 sheets of [ ]informal [X]formal sheets);
[X] Certified copy of **Germany** application Serial No. **19952608.7**;
[x] Other: Authorization Pursuant to 37 CFR 1.136(a);
[ ] Assignment to

FEE COMPUTATION

| CLAIMS AS FILED | | | | |
|---|---|---|---|---|
| FOR | NUMBER FILED | NUMBER EXTRA | RATE | BASIC FEE - $710.00 |
| Total Claims | 10 - 20 = | 0 | X $18 = | 0.00 |
| Independent Claims | 1 - 3 = | 0 | X $78 = | 0.00 |
| Multiple Dependent Claims, if any | | | $260 = | 0.00 |
| TOTAL FILING FEE . . . . . | | | = | $710.00 |

**Please charge Deposit Account No. 14-1270 in the amount of the total filing fee indicated above, plus any deficiencies. The Commissioner is also hereby authorized to charge any other fees which may be required, except the issue fee, or credit any overpayment to Account No. 14-1270.**

[ ] Amend the specification by inserting before the first line the sentence: This is a continuation-in-part of application Serial No. , filed .

**CERTIFICATE OF MAILING**

Express Mail Mailing Label No. EL458219317US

Date of Deposit NOVEMBER 2, 2000

I hereby certify that this paper and fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to The Commissioner for Patents Washington, D.C. 20231

Noemi Chapa
Name

Noemi Chapa
Signature

Send correspondence and papers to Corporate Patent Counsel
U.S. Philips Corporation, 580 White Plains Road, Tarrytown, New York 10591

Gregory L. Thorne, Reg. No. 39,398
Attorney
(914) 333-9665
Philips Electronics North America Corporation
580 White Plains Road
Tarrytown, New York 10591

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

MICHAEL BROESAMLE

Atty. Docket

PHD 99,151

Filed: CONCURRENTLY

FILM SCANNER WITH AN AUTOMATIC FOCUSING DEVICE

Commissioner for Patents, Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to calculation of the filing fee and examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, line 1, delete "DESCRIPTION" and insert the following heading:

--BACKGROUND OF THE INVENTION--;

before line 15, insert the following heading:

--SUMMARY OF THE INVENTION--;

Page 3, before line 5, insert the following heading:

--BRIEF DESCRIPTION OF THE DRAWINGS--;

line 11, insert the following heading:

--DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

## IN THE CLAIMS

Claim 1, line 3, change "characterized in that" to --wherein--.

Claim 2, line 2, change "characterized in that" to --wherein--.

Claim 3, line 2, change "characterized in that" to --wherein--.

Claim 4, lines 1-2, change "one of the preceding claims, characterized in that" to --claim 1, wherein--.

Claim 5, lines 1-2, change "one of the claims 1 to 3, characterized in that" to --claim 1, wherein--.

Claim 6, lines 1-2, change "one of the preceding claims, characterized in that" to --claim 1, wherein--.

Claim 7, lines 1-2, change "one of the preceding claims, characterized in that" to --claim 1, wherein--.

Claim 8, line 2, change "characterized in that" to --wherein--.

Claim 9, lines 1-2, change "one of the preceding claims, characterized in that" to --claim 1, wherein--.

Claim 10, lines 1-2, change "one of the preceding claims, characterized in that" to --claim 1, wherein--.

## IN THE ABSTRACT

Page 8, last line, delete "Fig. 1".

## REMARKS

The specification and claims have been amended to correct informalities in language and grammar, to add headings in accordance with MPEP Section 601, and to delete multiple dependencies.

The above amendments are submitted to place this application in proper U.S. format. Entry of the amendment and an early action on the merits are solicited.

Respectfully submitted,

By _____
Gregory L. Thorne, Reg. No. 39,398
Attorney
(914) 333-9665

# Film scanner with an automatic focusing device

## DESCRIPTION

The invention relates to a film scanner with an automatic focusing device in which the film images are shown line by line by means of an objective on at least one line sensor.

Manually focusing of film scanners inter alia has the drawback that the perception of the definition by human beings is irritated by the picture content. Furthermore, a relatively long dead time then exists, which leads to a transgression of the natural reaction and thus an "overwind" effect. This means that the user turns the adjusting knob, because the system cannot follow so fast and thus overshoots the goal to be attained. Especially with very brief scenes of, for example, 20s to 30s, as they often occur in commercials, it is thus hard to find the focal point.

It is true, various methods of automatic focusing are already known, for example, from EP 0 017 726 A1. However, they do not solve the problems discussed in the introductory paragraphs.

It is an object of the present invention to provide a film scanner with a focusing device that does not have the above drawbacks.

This object is achieved according to the invention, in that with a still film the adjusting range of the objective is passed through according to a predefined program, in that the then developing video signals are evaluated for their high-frequency component and in that the objective is adjusted to the maximum of the high-frequency component.

An advantageous embodiment of the invention is that the film is scanned in the interstice between two images (image gap). Also the grain of the film occurring in the image gap is used for the focusing.

Another embodiment of the invention is that the film is scanned within an image and that during the evaluation of the video signals the image content is suppressed particularly by autocorrelation.

A further embodiment including an advantageous evaluation of the video signals consists of the fact that for measuring the high-frequency component, differences are formed between the amplitudes of the picture elements neighboring the video signals. This

enables a measurement of the high-frequency component in simple calculation steps in a digital signal processor. Alternatively, however, there may also be provided that for measuring the high-frequency component, the video signals are subjected to a Fast Fourier Transform (FFT).

For the case where the color setting is not accurate enough after the whole adjusting range of the objective has been passed through and the video signals have subsequently been evaluated, in a further embodiment there may be provided that after the adjusting range has been passed through, a smaller range of the objective is passed through, which small range includes the previously defined maximum, and in that the objective is adjusted to a further maximum which is determined after the smaller range has been passed through. Depending on detailed conditions it is also possible to have several iterations in the sense of this further embodiment.

Another further embodiment comprises that for determining the maximum from the scanning values of each picture element obtained while the adjusting range is passed through, a respective curve is generated, that for each curve a maximum is derived and that an average value of the positions of the maximums is formed while the maximums that lie outside a predefined spread are not taken into account. Due to this averaging as such, statistical influences, more particularly noise portions of the signal, are excluded from the evaluation. Since the maximums that lie outside the predefined spread are not taken into account, it is particularly avoided that scratches on the carrier side opposite the layer lead to a distortion of the focusing.

In an advantageous embodiment of this further feature it is provided that for determining the maximums the respective function is differentiated and a zero is determined.

A further advantageous embodiment of the invention comprises that the video signals are written in a vertical format buffer and transmitted from there to a digital signal processor which is programmed for determining the maximum. This safeguards, on the one hand, that the digital signal processor can access signals as required which develop from successive scannings of the same picture elements. On the other hand, vertical format buffers can also be used, which are found in film scanners anyway, for example, for compensating for the so-called fixed pattern noise (FPN).

The still film may be damaged as a result of a lighting that lasts longer than 5s. Damage to the picture content owing to permanent lighting may be largely avoided when the above-mentioned embodiment of the invention is used, in which the image gaps are scanned. However, it has proved to be advantageous that in accordance with a further aspect, in line

with the predefined program the lighting of the film is controlled so that the film is not lighted when the scanning does not need this. With this further aspect, for example, a diaphragm can be opened for as long as the adjusting range of the objective is passed through.

Examples of embodiment of the invention are shown in the drawing with reference to a plurality of Figures and further explained in the following description, in which:

Fig. 1 shows a block diagram of a device according to the invention on a film scanner, and

Fig. 2 diagrammatically shows video signals used for the focusing.

Fig. 1 diagrammatically shows only the parts of a film scanner necessary for explaining the invention. The film 1 shown in enlarged form as regards its thickness is led by film-guiding elements 2, which also form a film gate 3. For the continuous scanning of the film 1, the film is moved, for example, in the direction of the arrow 4. The layer 5 of the film is then applied to the side of the film that does not contact the film-guiding elements 2.

A lighting device 6 lights the film via a filter 7 and a diaphragm 8. The diaphragm 8 may be an iris diaphragm having an additional diaphragm for completely interrupting the luminous flux. For clarity, Fig. 1 only diagrammatically shows one diaphragm (8) interrupting the luminous flux.

A respective lighted line is depicted on two line sensors 11, 11' with the aid of an objective 9 and a color ray divider 10. The line sensor 11 is then used for generating a luminance signal, whereas the line sensor 11' detects the chrominance information, which is not further explained in the example of embodiment shown. The invention may, however, also be used for film scanners having, for example, three sensors for the respective chrominance signals R, G and B. The output signal of the line sensor 11 is applied to an analog-to-digital converter 13 via a preamplifier 12 and can be tapped from the output 14 to be further processed, for example, buffered, gamma corrected and its chrominance adjusted.

From the output of the analog-to-digital converter 13 the digital video signal is further fed to a vertical format buffer 15. Its input and its output are connected by a bus system 16 to a digital signal processor 17. This digital signal processor 17 is connected via a DUAL PORT RAM 18 to a processor 19 which is used for controlling the whole film scanner. In film scanners used in practice such a task is usually spread over a plurality of processors which, however, is not essential to the explanation of the invention. In addition to

other functions, the processor 19 controls the focusing of the objective 9 via a driver arrangement 20. Furthermore, the processor 19 can control the lighting device 6 and, via a driver arrangement 21, the diaphragm 8.

In the example of embodiment shown, for the focusing of the inserted film 1 it is aligned by film drivers (capstan, rollers) that can also be controlled by hand, arranged so that in the film gate 3 an image gap comes to a halt. After a start command has been given, the processor 19 passes through the adjusting range of the objective according to a predefined program and during this time the diaphragm 8 is kept open. The video signals then developed are continuously written in a vertical format buffer 15 which is arranged as a FIFO memory, so that the signal processor 17 can detect via the bus system 16 pairs of time consecutive values of the same picture element and their differences. For all the picture elements and for all the instantaneous values occurring during the movement of the diaphragm, the differences are buffered in the digital signal processor 17. Due to the controlled movement of the objective 9, the instantaneous values correspond to the values for the corresponding position s of the objective 9.

After the adjusting range of the objective has been passed through, the digital signal processor 17 calculates curves, for example, splines for each picture element by connecting the respective curves of scanning values, and their maximums are determined by differentiating and zeroing. The maximum values are then averaged while values lying outside a spread are not taken into account. The result is then applied via the DUAL-PORT-RAM 18 to the processor 19 which determines a new, smaller adjusting range, opens up the diaphragm 8 again and passes through the new adjusting range of the objective. The described evaluation is then repeated and the result is again applied via the DUAL-PORT-RAM 18 to the processor 19, which then adjusts the objective 9 in accordance with the result.

Fig. 2 diagrammatically shows several lines of the video signal while the adjusting range of the object 9 is passed through (Fig. 1). x refers to the direction of the lines while the time t or covered distance s respectively, of the objective is shown perpendicular thereto. With the movement in the direction of the arrow, the focus shifts from bottom to top relating to the representation given in Fig. 1. Whereas in the line shown first no information can be recognized, in line 31 a scratch on the underside of the film begins to show.

With line 32 the scratch shows sharply and thus has a relatively large amplitude over several picture elements, so that also the differences to the neighboring picture elements become large. They diminish again in line 33 after which, after several lines, the grain of layer 5 (Fig. 1) first results in smaller (line 34) and then larger (line 35) and then

smaller again (line 36) amplitude differences. Due to the highly simplified representation in Fig. 2, of the signals determined by layer 5, only the maximum can be recognized in line 35. With the averaging described above also the line 35 comes out as the place having the largest sharpness, while line 32 is not taken into account in the evaluation.

CLAIMS:

1. A film scanner with an automatic focusing device in which the film images are shown line by line by means of an objective on at least one line sensor, characterized in that with a still film the adjusting range of the objective is passed through according to a predefined program, in that the then developing video signals are evaluated for their high-frequency component and in that the objective is adjusted to the maximum of the high-frequency component.

2. A film scanner as claimed in claim 1, characterized in that the film (1) is scanned in the interstice between two images (image gap).

3. A film scanner as claimed in claim 1, characterized in that the film (1) is scanned within an image and that during the evaluation of the video signals the image content is suppressed particularly by autocorrelation.

4. A film scanner as claimed in one of the preceding claims, characterized in that for measuring the high-frequency component, differences are formed between the amplitudes of the picture elements neighboring the video signals.

5. A film scanner as claimed in one of the claims 1 to 3, characterized in that for measuring the high-frequency component, the video signals are subjected to a Fast Fourier Transform (FFT)

6. A film scanner as claimed in one of the preceding claims, characterized in that

after the adjusting range has been passed through, a smaller range of the objective (9) is passed through, which smaller range includes the previously defined maximum, and in that the objective (9) is adjusted to a further maximum which is determined after the smaller range has been passed through.

7. A film scanner as claimed in one of the preceding claims, characterized in that
for determining the maximum from the scanning values of each picture element obtained while the adjusting range is passed through, a respective curve is generated, in that for each curve a maximum is derived and in that an average value of the positions of the maximums is formed while the maximums that lie outside a predefined spread are not taken into account.

8. A film scanner as claimed in claim 7, characterized in that
for determining the maximums the respective function is differentiated and a zero is determined.

9. A film scanner as claimed in one of the preceding claims, characterized in that
the video signals are written in a vertical format buffer (15) and transmitted from there to a digital signal processor (17) which is programmed for determining the maximum.

10. A film scanner as claimed in one of the preceding claims, characterized in that
in line with the predefined program the lighting of the film is controlled so that the film (1) is not lighted when the scanning does not need this.

ABSTRACT:

In a film scanner with an automatic focusing device in which the film images are shown line by line by means of an objective on at least one line sensor, with a still film the adjusting range of the objective is passed through according to a predefined program. The then developing video signals are evaluated for their high frequency component. The objective is adjusted to the maximum of the high frequency component.

Fig. 1

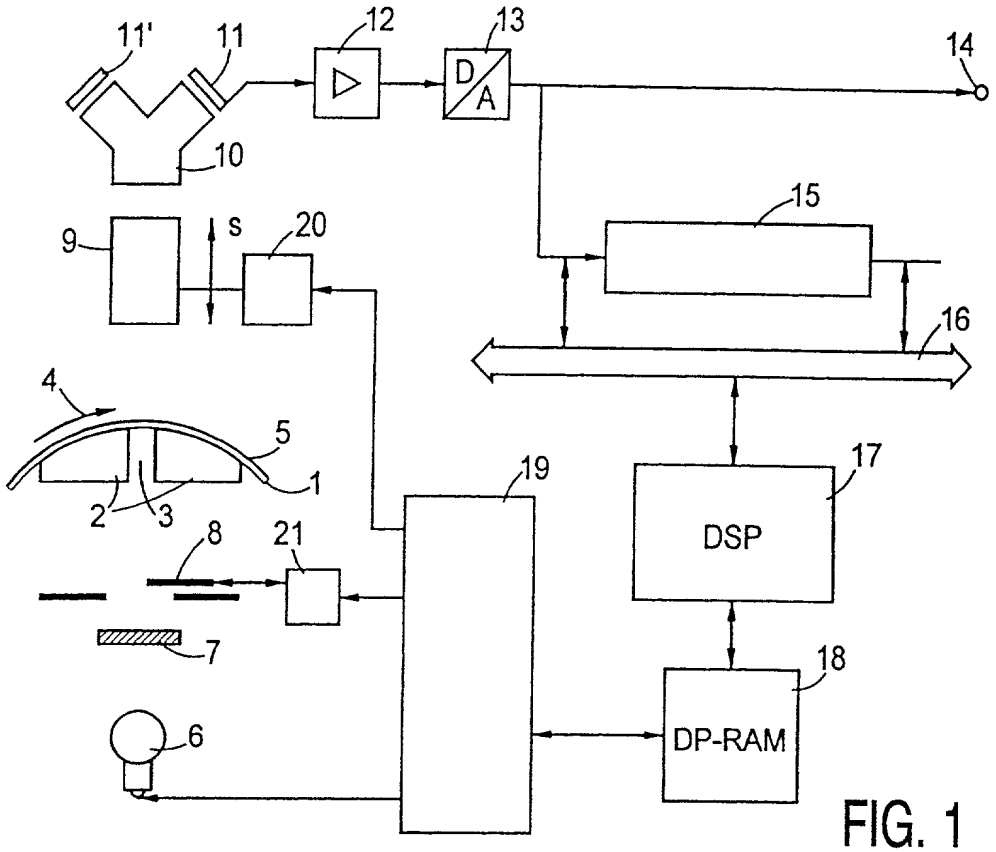
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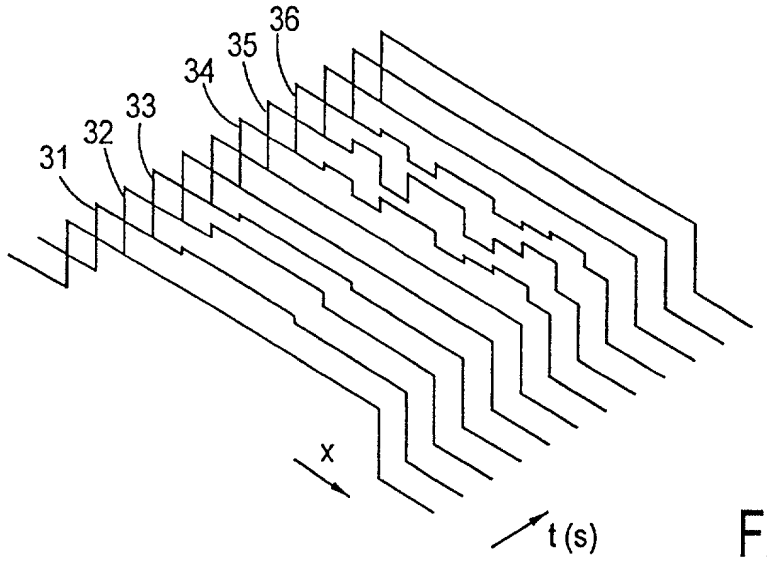
FIG. 1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31
x
t (s)

FIG. 2

# DECLARATION and POWER OF ATTORNEY

ATTORNEY'S DOCKET NO.:
**PHD 99.151**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

"***Film scanner with an automatic focusing device***"

the specification of which (check one)

☐ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the amendment(s) referred to above.

I acknowledge the duty to disclose information which is material to patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

| COUNTRY | APP. NUMBER | DATE OF FILING (DATE, MONTH, YEAR) | PRIORITY CLAIMED UNDER 35 U.S.C. 119 |
|---|---|---|---|
| **Germany** | **19952608.7** | **02 November 1999** | **YES** |
| | | | |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1,56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

PRIOR UNITED STATES APPLICATION(S)

| APPLICATION SERIAL NUMBER | FILING DATE | STATUS (PATENTED, PENDING, ABANDONED) |
|---|---|---|
| | | |
| | | |

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Jack E. Haken, Reg. No. 26,902
Michael E. Marion, Reg. No. 32,266
Edward M. Blocker, Reg. No. 30,245

| SEND CORRESPONDENCE TO: Corporate Patent Counsel;<br>U.S. Philips Corporation; 580 white Plains Road;<br>Tarrytown, NY 10591 | DIRECT TELEPHONE CALLS TO:<br>(name and telephone No.)<br>(914) 332-0222 |
|---|---|

| Dated: | Inventor's Signature: | | | |
|---|---|---|---|---|
| Full Name of in Inventor | Last Name<br>**BROESAMLE** | First Name<br>**Michael** | Middle Name | |
| Residence & Citizenship | City<br>**Weiterstadt** | State of Foreign Country<br>**Germany** | Country of Citizenship<br>**Germany** | |
| Post Office Address | Street<br>**Mainzer Str. 20** | City<br>**D-64331 Weiterstadt** | State of Country<br>**Germany** | Zip Code |